Air Force Research Laboratory | AFRL

Science and Technology for Tomorrow's Aerospace Forces

Success Story

IN-HOUSE EXPERTISE IN NANOTECHNOLOGY BOOSTS DEVELOPMENT OF CONSUMER PRODUCTS WHILE REDUCING AIRCRAFT AND SPACE VEHICLE COSTS

Polymer-matrix nanocomposites could replace composite and polymer materials currently used to design and manufacture critical substructures in aircraft and space vehicles, fuel-line brackets, combustion chambers, and cryogenic storage containers, resulting in substantial weight and cost savings. Transfer of this new technology to private industry led to a licensing agreement between Triton Systems, Inc., and a major athletic shoe company for the production of helium-filled pouches for athletic shoes. Scientists are studying nanocomposites for a number of other innovative commercial applications.

Air Force Research Laboratory
Wright-Patterson AFB OH

Accomplishment

Extensive in-house research and development (R&D) efforts at the Materials and Manufacturing Directorate, together with R&D efforts at Triton Systems, Inc., reduced the weight and cost of aerospace composites and polymer structural materials used on air and space vehicle systems. This technology uses nanocomposites with nano-reinforcements 10,000 times smaller than the diameter of a human hair to manufacture components vital to both military and commercial systems. This technology will also benefit commercial industry through the successful design and development of dynamic new consumer products.

Background

The increased performance needs of future aircraft and space vehicle systems require high-use temperature, lightweight, polymeric materials. Triton Systems, Inc., with directorate support under the Small Business Innovation Research program, developed a new generation of polymer-matrix nanocomposites based on the molecular-level dispersion of highly anisotropic, inorganic, nano-scale rods or plates. This polymer-matrix nanocomposite is similar to mica-type layered silicates in a thermoplastic polymeric resin.

Polymer nanocomposites exhibit significant increases in thermal stability and over a 10-fold improvement in barrier to oxygen and water vapor compared to neat polymer resins. These property improvements extend the number of potentially useful environments of polymeric material. Additionally, nano-scale inorganic particles comprise less than 10% of the weight of the nanocomposites, in comparison to conventional filled-polymer systems where inorganic materials comprise more than 30% of the weight. The overall weight of the nanocomposite is less than that of conventional composites, while enabling the same important property enhancements.

Dr. Richard Vaia and other research professionals in the directorate's Polymer Branch transferred these material technology advancements to the commercial sector. The impact of this technology transfer may be international in scope, since shoe manufacturers distribute these products to more than 90 countries worldwide.

The athletic shoe uses helium-filled capsules to provide greater cushioning and shock absorption over conventional shoes. This technology enabled shoe manufacturers to design a lower heel, placing the foot 25% closer to the ground than other athletic shoes. Since helium is difficult to encapsulate in plastic, Triton Systems Inc., used nano-scale platelets in the capsules to prevent the gas from escaping.

Materials and Manufacturing
Technology Transfer

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTT, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (01-ML-07)